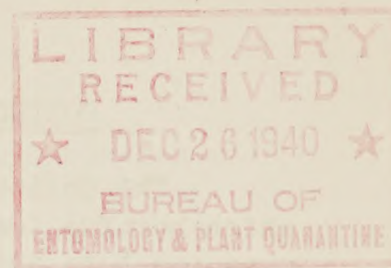


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UNITED STATES DEPARTMENT OF AGRICULTURE
Bureau of Entomology
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(NOT FOR PUBLICATION)

MEMORANDUM REGARDING THE CONTROL OF INSECTS ATTACKING CERTAIN
VEGETABLES, SMALL FRUITS AND TOBACCO AND THE ELIMINATION OF
HARMFUL INSECTICIDAL RESIDUES FROM THE MARKET PRODUCT

This memorandum supersedes the one issued by the Bureau under date of February 1, 1933 and addressed to Experiment Station and State Entomologists. The developments of the 1933 season at the various Bureau laboratories have made desirable certain changes in the recommendations issued last year.

The use of lead arsenate is not recommended for the control of insects attacking any vegetable crop considered in this memorandum.

The use of other arsenicals and cryolite is, however, suggested as control for certain insects on several of the crops under consideration. This suggestion is made with the provision that the poison should not be used after the appearance on the plant of fruit or foliage which will be sent to market or consumed except in such cases where washing or stripping will remove all spray residues.

In the interests of the vegetable industry, it is strongly urged that the growers be warned of the poisonous nature of arsenicals and like materials and that they take especial precautions to see that none of these materials remain on the market product.

The Bureau's researches on methods of control which will eliminate harmful insecticidal residues are being continued at the following laboratories: Chadbourn, N. C., Charleston, S. C., Baton Rouge, La., Columbus, Ohio, Clarksville, Tenn., Alhambra, Calif. and Biloxi, Miss. The principal pests involved in these tests will be the cabbage worms, bean beetle, pepper weevil, vegetable weevil, melon and pickle worm, strawberry weevil and tobacco hornworm.

CONTROL RECOMMENDATIONS OF SOME IMPORTANT TRUCK CROP PESTS

The following recommendations are applicable only to certain crops on which harmful insecticidal residues may occur on the marketed product. The measures here outlined for the control of insects attacking such crops are the best methods available that can be recommended and which will reduce to a minimum or eliminate residues from treatments with arsenic or other poisonous insecticides.

CABBAGE PESTS

For the control of the common cabbage worm, cabbage looper, cabbage webworm, and diamond-back moth on cabbage, the following materials are recommended in the order listed:

Dusts

- (1) Derris or other rotenone dusts
- (2) Pyrethrum
- (3) Paris green 1 part and lime 9 parts
- (4) Cryolite (sodium fluoaluminate) 1 part
and talc or clay or tobacco dust 1 to 2 parts
- (5) Calcium arsenate, undiluted

NOTE: Paris green, cryolite and calcium arsenate should not be used on the cabbage crop in the South within forty days of harvesting time and should not be used in the North after the cabbage has started to head.

Sprays

- (1) Pyrethrum-derris extract combined
- (2) Paris green 1 lb., lime 4 lbs., water
50 gals., sticker or spreader.

Derris dusts containing .5% to 1.5% rotenone have given very promising results in four sections of the Eastern and Southern States. Satisfactory diluents for the derris root powder are finely-ground tobacco dust, finely pulverized clay, or talc. Clay and talc have the advantage of being more economical in cost and more readily available in some sections than tobacco dust. On the other hand both have the disadvantage of leaving an objectionable whitish deposit on the cabbage when applied near the harvesting period. The use of tobacco dust eliminates the appearance of undesirable deposits on the plant, and may aid in the control of aphids under favorable climatic conditions. Derris retains its insecticidal value a longer period than does pyrethrum. In Ohio excellent results were obtained with commercial dusts containing approximately .55% rotenone against the cabbage looper and common cabbage worm.

Derris Dusts

The rotenone content of derris (or cubé) root varies, and purchases should be made on the basis of rotenone content. The rotenone content of the finished mixed dust of course depends on the amount of diluent used as well as on the amount of rotenone in the original material. Insecticide companies now sell high grade finely ground derris powder of specified rotenone content by blending the various analyzed batches. To prepare a dust containing 1% rotenone, use the following formula:

Derris powder (4% rotenone)	25 lbs.
Tobacco dust (or talc or clay)	75 lbs.

To prepare a dust containing one-half per cent rotenone, use the following:

Derris powder (4% rotenone)	12-1/2 lbs.
Tobacco dust or clay	87-1/2 lbs.

If the rotenone content of the derris or cubé powder is greater or less than 4%, then the proportions of inert diluent must be varied accordingly. For instance, a derris powder containing 5% rotenone should be mixed with 4 parts of diluent by weight, that is, 20 lbs. of the derris powder containing 5% rotenone and 80 lbs. of tobacco dust, talc or clay, to obtain a 1% rotenone dust.

Sulphur has also been used successfully as a diluent on cabbage and squash.

Pyrethrum

Pure fresh pyrethrum dust, diluted with equal parts of tobacco dust, sulphur or finely pulverized clay, has shown very promising results. Applications should be made in the afternoon or evening. It is a contact insecticide and has no apparent residual value. The commercial pyrethrum extracts vary as to pyrethrin content, and the directions as given by the manufacturer should be used as a basis for the dilution of these materials. Commercial pyrethrum-derris extracts in combination have given good results in Ohio, when used at twice the strength recommended by the manufacturers.

Paris Green

The 1932 and 1933 results indicate that Paris green may be used at a dilution of 1 pound to 9 pounds of hydrated lime, using 20 pounds of the mixture per acre per application (2 pounds of Paris green to the acre) until 40 days before harvest under Louisiana and South Carolina conditions. In the experiments performed the headed cabbage was stripped to four loose outer or wrapper leaves before being analyzed for arsenical residues. The time elapsing between the last application and the date of harvest is apparently more important from the residue standpoint than is the number of arsenical applications. Under conditions of extreme drought it may be found that arsenical applications should be discontinued more than 40 days prior to harvest.

In Ohio where a different variety of cabbage was used and growing conditions differ from those in the South, the cabbage may be treated up to the time the head begins to form, that is, when the outer leaves of the plant remain intact and all new leaves grow from the inside. The outer leaves should be stripped before marketing the product.

Cryolite (Sodium fluoaluminate)

Both synthetic and natural cryolite have given favorable results during the past season. In Louisiana the synthetic material diluted with 2 parts of talc gave as good or better control than Paris green 1 part, hydrated lime 10 parts. In the Carolinas the natural cryolite gave good results when diluted with 2 to 4 parts of either tobacco dust, talc, or clay, used at the rate of 15 to 20 lbs. per acre per application.

Calcium Arsenate (Undiluted)

Undiluted calcium arsenate gave fair results in the Carolinas, but gave poor results in Louisiana. In Ohio it was not effective when used at 3 pounds to 50 gallons of water with caseinate of lime, 1/2 pound to 50 gallons.

CAULIFLOWER, BROCCOLI, KALE AND COLLARDS

The Bureau has not yet had an opportunity to conduct any extensive experiments on the control of cabbage pests on cauliflower, broccoli, kale or collards. In general it is believed that the derris and pyrethrum products should give the same results on these crops as when used on cabbage.

Little or no danger should result from the treatment of these crops with arsenicals in the seedling stage. The leaves surrounding the heads of cauliflower are oftentimes used for food, and the treatment of the crop should be so regulated that these leaves do not bear any poisonous residue. Extra precautions should be taken in the use of arsenicals or other poisonous materials on broccoli as the nature of the edible part of this plant is such that there is very little likelihood of residues being removed by washing or stripping. The edible portion is also liable to hold and carry a residue for a considerable length of time.

CELERY INSECTS

Celery Leaf Tier: The celery leaf tier is the major pest of celery in the Florida producing area, and also periodically becomes troublesome in the North and in California. This pest can be controlled by careful treatments with pyrethrum dust, the dust being mixed with an equal quantity by volume of tobacco dust or hydrated lime. Tobacco dust has proven more satisfactory than other materials as a diluent and is recommended. The treatment consists of making two applications within a period of one-half hour. The object of making the second treatment within such a period is to kill those

worms which have moved from the web as a result of the first treatment. Approximately 25 pounds of the mixture per acre are necessary for each application. Except under unusual conditions in the Florida area, one treatment, that is, two applications at a half-hour interval, is sufficient to protect any one given area of celery.

Arsenicals are not satisfactory as a control for this pest and are not recommended.

Celery Looper: Several species of loopers attack celery. In Florida these pests are usually held in check by a bacterial disease, and observations so far would indicate that ordinarily no artificial control measures are necessary. These pests succumb readily to treatments of pyrethrum powder as recommended for the celery leaf tier, and arsenical applications are not necessary.

Cutworms: The use of an arsenical bait is the only practicable means for the control of the majority of the species of cutworms attacking celery. The risk from poison residue can be eliminated by the distribution of one of the standard cutworm baits between the rows, provided care is taken to keep the bait from falling on the plants.

Cultural Practise: Under Florida conditions, the cleaning up of the crop refuse after harvest is valuable in pest control, particularly of the celery leaf tier.

SQUASH INSECTS

The indications are that the melon and pickle worm may be satisfactorily controlled in North and South Carolina, and probably elsewhere, by dusting with a derris powder mixture containing from .5% to 1.5% rotenone. In cases of light infestations the .5% dust should be sufficient if applied early and regularly. Where the infestation is heavy the 1% or the 1.5% dusts should be used. Sulphur seems to be the most effective diluent for melon and pickle worms, possibly because of some action against young larvae. The addition of from 10 to 25% of talc, clay, or wheat flour or finely-ground tobacco dust to the derris-sulphur mixture will improve its dusting qualities.

The treatments should begin when the worms first appear on the leaf buds of the squash plant, which may be within a week or ten days after the plants appear above ground, and continued at 7 to 10 day intervals as long as the worms are present or the crop is being harvested. The rate of application will depend upon the size of the plants, and should range from 15 to 25 pounds per acre. Extreme care should be exercised to see that the growing tips of the plants are well covered with the dust as the worms feed extensively on the young leaf buds before tunneling into the fruit, stem and vines.

Pyrethrum powder has also proved of value in the control of these pests. The pyrethrum powder should be used in a mixture with clay or talc and sulphur, using equal parts of the pyrethrum and the diluent.

Cryolite and Paris green may be used to advantage in early treatments. In order to avoid danger of poisonous residues on the market product, treatment with these materials should not be made after the fruit has begun to set. The Paris green should be diluted with sulphur and lime in the ratio of one pound of Paris green, four and one-half pounds sulphur and four and one-half pounds lime. The addition of lime to the mixture is necessary in order to reduce the danger of injury to the plants.

Cryolite may be mixed with clay and sulphur in the ratio of one pound of cryolite to one pound of clay to three pounds of sulphur.

Calcium arsenate has not proven satisfactory as a poison for the melon and pickle worm.

A bellows type duster is more satisfactory for the treatment of the squash crop than the rotary type because of the method of planting and also the necessity of applying the material directly to the growing tips of the plant.

LETTUCE AND SPINACH INSECTS

There are several leaf-feeding forms which may attack lettuce and spinach and on occasions cause considerable damage. Pyrethrum or derris is recommended as substitutes for the arsenicals in order to safeguard the health of the consumer.

PEPPER INSECTS

Pepper Weevil: While the pepper weevil can be controlled by treating the crop at regular intervals with undiluted calcium arsenate, this method is not to be recommended unless the residue can be adequately removed by washing. Then too, the regular treatment of the crop with calcium arsenate may result in heavy infestations of plant lice which are capable of causing more crop loss than pepper weevil infestation.

For conditions which obtain in California, cultural control is recommended. This involves complete destruction of pepper plants after harvest, and also the clean-up of night-shade plants in the vicinity of the pepper fields, the night-shade being a favorite winter host of the pepper weevil. The pepper fields should be plowed at least by January 1 and all night-shade plants destroyed by the 10th of January. This gives a period between the destruction of the winter host plants and the planting of the seed bed in excess of the time which is possible for pepper weevils to live on other than their normal host plants. No experiments have been conducted on the control of pepper weevil in New Mexico or Texas, and no recommendations are made for the control of this pest in these two areas.

BEAN INSECTS

Mexican Bean Beetle: The best control for the bean beetle is spraying with magnesium arsenate, the spray mixture being used at the rate of 2 pounds to 50 gallons of water or 2 ounces to 3 gallons. (Note the increase of the amount of magnesium arsenate over that previously recommended.) The poison must reach the undersides of the leaves, and the spraying must be done thoroughly. Begin spraying when the adults are found in the field or the eggs of the beetle become numerous on the undersides of the leaves. One to three, sometimes four, applications are required, depending on the abundance of the insect.

It is important that all applications of magnesium arsenate to snap beans should stop when the pods begin to form. If later treatments prove necessary, a derris or a rotenone dust should be used. Investigations thus far indicate that a dust containing .5% to .6% rotenone is satisfactory. These dusts may be purchased ready-mixed or may be mixed on the farm, in accordance with instructions given herein under derris dusts.

Synthetic cryolite (sodium fluoaluminate) has been found to be an effective substitute for magnesium but the dosage must be increased. It should be used at the rate of 3 lbs. to 50 gallons of water and should be applied in the same manner as magnesium arsenate. Applications must be discontinued when pods begin to form, as in the case of magnesium arsenate.

As important as thorough spraying is the destruction of the crop remains after harvest. Plow under all plant remnants at least 6 inches deep.

Dusting may be practised, but does not give as good results as spraying; and when calcium arsenate mixtures are used, plant injury often results. Lead arsenate should never be used on bean foliage. Serious injury and reductions in yield often result from its use, even with Bordeaux mixture.

While the use of cryolite as a dust is not very satisfactory, it may be used undiluted or diluted with tobacco dust, clay or talc or some other materials which have been recommended.

Other leaf-feeding bean insects, particularly the bean leaf beetle, the green clover worm, and flea beetles, may usually be controlled by following the above recommendations.

See Farmers' Bulletin 1624, "The Mexican Bean Beetle and Its Control," for detailed instructions.

STRAWBERRY INSECTS

Strawberry Weevil: A careful study of the hibernation habits of the strawberry weevil in North Carolina shows that the destruction of the weevil by burning over its hibernating areas is a most effective means of reducing losses from attacks of this pest.

Such burning is necessary only over areas within 100 feet of the strawberry field, as observations have shown that 97 per cent of all weevils hibernate within 100 feet of the cultivated areas. The burning should be carried on in the winter and not in spring, and every precaution should be taken to prevent such fire from getting out of control.

When the burning method can not be applied, satisfactory control of the strawberry weevil may be obtained by dusting with a mixture consisting of calcium arsenate 1 pound and sulphur 5 pounds. The first application should be made as soon as the weevil appears in the field. The rate of application will range from 10 to 30 pounds per acre per application, depending upon the density of the strawberry planting. Ordinarily two applications are all that are necessary to protect the early fruit. All applications of poison dusts should be discontinued at least three weeks prior to the ripening of the first berries. Where a long bearing season obtains, the treatment with an arsenical poison after this period may result in harmful residues on the ripened berries.

VEGETABLE WEEVIL

The vegetable weevil is an important pest of vegetable crops in Texas, Arkansas, Louisiana, Mississippi, Georgia and Florida. It is also known as a pest in the San Jose, Calif. section. The following methods are recommended for its control:

1. Cultivation during the period when the insects are in the ground.
2. Poison baits scattered between rows and on headlands as soon as the first damage is noticed in the spring. The bait that has been most effective consists of: sodium fluoride 1 pound, wheat bran 15 pounds, to which is added 1 pound of dehydrated or 8 pounds of freshly chopped turnips or carrots, with sufficient water to form mash. Apply late in afternoon to prevent excessive drying out.
3. Crop rotation where possible, to avoid building up infestations through continuous cropping with favorite hosts.
4. The treatment of crop remnants with arsenicals after the crop is harvested is advocated as a means of reducing weevil populations.
5. Field sanitation. All rubbish and weeds where the insect may find shelter during inactive periods should be cleaned up.

TOBACCO INSECTS

Although tobacco is not a food, it would appear that arsenical or other poisonous residues on tobacco may be harmful to the consumer, and therefore every precaution should be taken to keep the residues from insecticides on tobacco at a minimum.

Tobacco Hornworms: Tobacco hornworms may be controlled by dusting with a mixture of Paris green, 1 part, and lime 4 parts. The rate of application should vary from 4 to 6 pounds of the mixture per acre, depending upon the size and type of the tobacco. Special care should be observed in the manipulation of the crank duster in order to obtain a good coverage of the crop, while at the same time keeping the rate of application low.

Flea Beetles: Barium fluosilicate is an efficient flea beetle insecticide. Undiluted it may be used at the rate of one-half pound per 100 square yards of tobacco planted. For larger transplanted tobacco, 3 to 5 pounds per acre are required.

Cultural and other controls: Fall plowing is very effective in reducing the number of overwintering pupae of the hornworm.

Handpicking of the worms, where the acreage is limited, can be practised to advantage, especially with low-priced labor.

Considerable progress has been made in an attempt to control tobacco hornworm moths by means of a special poison feeder containing tartar emetic for the stomach poison. An attractant used in conjunction with the feeder is amyl salicylate. Consult the Bureau of Entomology for further particulars.

CLEAN-UP MEASURES

Emphasis should be placed on the thorough cleaning up of crop remnants after harvest. It has been observed, in the southern producing areas particularly that fields of harvested cabbage and other similar crops serve as a source of infestation to the new plantings.

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